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ABSTRACT

An investigation reviewed current literature in the field of physiological factors affecting the adult learning environment. These findings were compared to the academic learning environment at the Phoenix Air National Guard. The end product was a set of recommendations for management to implement in order to improve the learning climate for the Phoenix Air National Guard members. It was found that the effects of aging (loss of vision, reduction in hearing discrimination, and slower reaction times) influence the learning ability of Air Guard members. The classroom survey showed that several rooms need additional insulation, more lighting, and better air conditioning. Recommendations centered around annual physical examinations for all employees over the age of 40, the need for the initiation of repair orders for physical plant corrections, and the need for management in general to analyze carefully the physiological factors affecting learning and to incorporate changes that would improve the opportunities for learning by all Air Guard employees. (YLB)

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A STUDY OF THE PHYSIOLOGICAL FACTORS AFFECTING THE NATURE OF THE ADULT LEARNER IN THE PHOENIX AIR NATIONAL GUARD

Societal Factors Affecting Education

by

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A Practicum presented to Nova University in partial fulfillment of the requirements for the degree of Doctor of Education

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ABSTRACT

The Phoenix (Arizona) Air National Guard is made up of over 1,000 adult learners varying in age from 17 to 60 years. This 43 year age span is not taken into consideration in relation to the learner's physiological factors that might be affecting his or her ability to assimilate material. No environmental or procedural changes presently take place in relationship to classroom size, physical plant layouts, teaching materials, or printed matter when dealing with this working population.

This investigation was designed to review current literature in the field of physiological factors affecting the adult learning environment and to compare these findings to the academic learning environment at the Phoenix Air Guard. The end product is a set of recommendations for management to implement in order to improve the learning climate for the Phoenix Air Guard members.

It was found that the effects of aging (loss of vision, reduction in hearing discrimination, and slower reaction times) influences the learning ability of Air Guard members. The classroom survey showed that several rooms need additional insulation, more lighting, and better air conditioning.

The recommendations centered around annual physical examinations for all employees over the age of 40, repair

orders need to be initiated for physical plant corrections, and management in general needs to carefully analyze the physiological factors affecting learning and to incorporate changes that would improve the opportunities for learning by all Air Guard employees.

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Chapter 1

INTRODUCTION

Nature of Problem

The Phoenix (Arizona) Air National Guard (referred to as the Phoenix Air Guard) is composed of over 1,000 adult learners varying in age from 17 to 60 years. These guardsmen fall into the age stages by the following percentages: Adolescence (5%), Early Adulthood (47%), Middle Age (28%), Maturity (19%), and Later Maturity (1%). The population is 12% female and 88% male. The oldest female person is 42 years old.

In the Air Guard system, this 43 year age span is not taken into consideration in relation to the learner's physiological factors that might be affecting his or her ability to assimilate material. No environmental or procedural considerations presently take place in relationship to classroom environment, physical plant layouts, teaching materials, printed matter, or age group.

Knowles (1984:181) feels that learning is a process of active learning. The purpose of education is to facilitate the development of competence required for performance in life situations. Learning must be a lifelong process, and the physical environment of the learner must not detract from this process. The physical environment

requires provisions for animal comforts (temperature, ventilation, easy access to refreshments and rest rooms, comfortable chairs, adequate light, good acoustics, etc.) to avoid blocks to learning (Knowles, 1980:91). Thus, physical environment and life interest have a relationship when it comes to learning effectiveness.

Purpose of Investigation

This investigation was designed to review current literature in the field of physiological factors affecting the adult learner and to compare these findings to the academic learning environment at the Phoenix Air Guard. The end product is a set of recommendations for management to implement in order to improve the learning climate for the Phoenix Air Guard members.

Chapter 2

BACKGROUND AND SIGNIFICANCE

Relationship to Seminar

In the study guide for Societal Factors Affecting Education, age was listed as a social and demographic category that influences extensively the scope and complexity of education. This practicum deals directly with the physiological factors that affect the learner's ability to learn.

The psychology of the adult, not too young, and not too old, is more than a sad saga of proceeding from bifocals to trifocals and dentures to death. The middle-age adult has as many problems to solve and pleasures to enjoy as any child or adolescent (Bischof, 1969:1).

Knowles (1980:28) expressed the opinion that one mission of the adult educator, then, can be stated positively as helping individuals to develop the attitude that learning is a lifelong process and to acquire the skills of self-directed learning. The societal factors seminar stressed the importance of understanding aging and its relationship to adult learners. Knowles, Bischof and others were reviewed in order to focus on learning in relationship to the adult education in the Phoenix Air

Guard, the physical environment and the aging process. All of these works are explored in detail in several of the following sections.

Institutional Perspective

The physiological factors tables and facility evaluations would assist the management of the Phoenix Air Guard in making alterations to classrooms in the hopes of improving learning conditions within the Phoenix Air Guard.

Review of Literature

This section of the study deals with the basic theories behind aging and the adult learner. It then reviews the current literature concerning the establishment of proper learning environments.

Physiological Factors and Aging

Houle (1961) is quoted as saying: "Age is important; the very young adult seldom cares about aging, but there is a sharp upturn in interest during the late twenties, a fairly constant level of interest until the age of fifty, and then starts a gradual decline after this period" (Houle in Lumsden, 1985). In contrast, Cropley (1977:98) has determined that there are five stages of life, ranging from infancy through early childhood, to young adulthood, adulthood, and old age. Shifts in values and emphasis with increasing age are described not as the failure of youth, but as the mastery of new levels of transcendence.

Basically, the fact is that a very great deal of the social learning people do occurs during adult life, long after traditional schooling has been completed (Cropley, 1977:8).

In Lowe's study on aging, he refers to the work of R. J. Havighurst (Lowe, 1975:52). Havighurst calls aging factors "dominant concerns" and summarizes them relative to each age period as follows:

1. Age 0-10 years: coming into independent existence.
2. Age 10-20 years: becoming a person in one's life.
3. Age 20-30 years: focusing one's life.
4. Age 30-40 years: collecting one's energies.
5. Age 40-50 years: exerting and asserting oneself.
6. Age 50-60 years: maintaining position and changing roles.
7. Age 60-70 years: deciding whether to disengage and how.
8. Age 70-80 years: making the most of disengagement.

Havighurst also sets names to each life span period (Havighurst in Cropley, 1977:99). He calls them developmental stages. These stages are:

1. Infancy and Early Childhood: 0-6 years.
2. Middle Childhood: 6-12 years.
3. Adolescence: 12-18 years.
4. Early Adulthood: 18-29 years.

5. Middle Adulthood: 30-35 years.
6. Maturity: 35-55 years.
7. Later Maturity: 55 plus years.

Knox (1977:252) presents the following concepts about aging and physical changes.

1. Especially after middle age, the loss of muscle cells has an impact on both strength and appearance.
2. Physical strength reaches its peak during the twenties and then gradually declines.
3. Old people are less able to respond effectively to extremely high or low environmental temperatures.
4. During adulthood, the aging eye and the related nervous system gradually reduce the quantity and quality of visual information that is received.
5. Men experience greater hearing loss than women beyond their fifties, largely as a result of occupational exposure to noise.
6. The sense of touch increases until age 45 and then becomes less acute, and sensitivity to pain declines.

When looking at maturity and aging, J. R. Kidd (1965:64) shares the opinion that from maturity on it is normal for the human organism to undergo the following kinds of changes, most of which occur gradually:

1. Cell tissue becomes drier. They do not grow so rapidly and the repair of cell tissue proceeds more slowly.
2. Body cells become somewhat less elastic.
3. The rate of basal metabolism is lowered.
4. There is a decrease in speed, intensity, and endurance of neuromuscular reactions.
5. Vision and hearing become impaired.

In closing, Lowe (1975:50) reflects that what adults lose in maturational decline is compensated for by impact from the environment. What is lost in reasoning, speed, and perception is gained in experience, knowledge, and wisdom -- provided, of course, that mental stimulation is constant.

Physical Facilities and Learning

Kurpius (1978:80) summarizes physical facilities and the adult learner by saying that the easiest accomplished procedure for bringing about behavior change involves environmental change. If such a change is feasible, the change represents the most economical system available. Kurpius continues by saying that people respond to cues and stimuli in their social and physical environment.

Providing opportunity, reducing excitement level and reducing chances for mistakes are methods that have been used to alter the learning environments of adult basic learners in order to improve learning outcomes (Kurpius 1978:82).

Vocational and family life interest tend to dominate the pattern of concerns of young adults (age 18 to 35) as they seek to establish themselves in work and home (Knowles, 1980:91). Knowles identifies measures of the efficiency of operation of the physical plant of the following type:

1. Is there adequate space for the kind of program required to achieve the objectives of the organization?
2. Is the space suitable, in terms of location, decoration, and furnishings?
3. Are the physical facilities maintained in good condition in regard to heat, light, ventilation, and sanitation?
4. Is there adequate administration and instructional equipment? Is it properly safeguarded and maintained in good condition?
5. Is provision made for the replacement or renewal of physical facilities before they deteriorate to such an extent as to interfere with efficiency of operation?
6. Is the space and equipment used close to capacity as is practicable?

In closing, Kurpius believes that facilities and services play major roles in fulfilling the needs of the adult learner. If educators could be brainwashed, according to Kurpius (1978:107), to look upon themselves as business people and students as consumers, their relationship with

students would probably be changed. Producers know that the very existence of any business depends upon its ability to provide a product or service which the consumer personally experiences as needed, desirable, and worth purchasing (Kurpius, 1978:107).

Chapter 3

PROCEDURES AND METHODOLOGY

A descriptive method of research was conducted to formulate several physiological factor tables. A check sheet was used to examine classroom facilities at the Phoenix Air Guard, and the results were documented. Logical conclusions and recommendations were made that drew upon the findings of this examination. This investigation was designed to review current literature in the field of physiological factors affecting the adult learner and to compare these findings to the academic learning environment at the Phoenix Air Guard.

Definition of Terms

The following terms are defined for the purpose of this study:

1. Age is defined as an individual's development measured in terms of the years requisite for like development of an average individual.
2. Environmental factors are defined as those physical plant elements that affect lighting, noise, and classroom temperatures.
3. Phoenix Air Guard is defined as a unit of the National Guard of Arizona.

4. Physiological factors is defined as the science that affects life processes, activities, and functions.

Limitations of the Study

A limitation that is imposed is that of the quality of the environmental test equipment used for the gathering of data regarding classroom conditions. All tools and instruments were loaned from other governmental agencies and more sophisticated test equipment may alter results. The limitation placed on the testing of classroom environments due to operational error of equipment and inaccurate data readings has to be seen as a very small limitation, but worthy of mention.

A second limitation is that facilities, other than those listed, cannot be used to meet the goals of the study. In keeping with this limitation, funding for new facilities is controlled by the federal government, therefore the construction of new facilities is not an option.

Due to the military security requirements certain classrooms could not be evaluated and mentioned in this report. These areas are used for classified briefing and as such cannot be discussed.

A final limitation is the age of certain facilities has not been used as an evaluation item on the check sheet. The older facilities, some over 30 years of age, are harder to maintain and to make repairs upon. The wiring diagrams

and the general deterioration of the plumbing makes repairs extremely difficult and costly. Several facilities are converted aircraft hangars and as a result have little or no insulation and are located well within the noise paths of departing and landing jet aircraft.

Chapter 4

PRESENTATION OF RESULTS

An intensive review of the literature concerning the nature of the adult learner has fostered the concept that learning must be a lifelong process (Knowles, 1984:181). Learning becomes efficient when it takes into consideration the physiological and environmental factors affecting the adult. A selected review of the works on learning and physiological factors, as authored by Bischof (1969), Cropley (1977), Kidd (1965), Knowles (1950), Rossman (1984), and Verner (1971) were used to produce the following physiological factor tables aligned to the year stages as defined by Havighurst (Havighurst in Lowe, 1975:52). These stages are adolescence, early adulthood, middle age, maturity, and later maturity.

Next, the chapter includes a look at the eleven classrooms of the Phoenix Air Guard base facility in the environmental areas of temperature, lighting, and physical design. Areas were surveyed and reported upon to identify physical plant limitations that would alter the adult learner's ability to comprehend material.

Physiological Factors

Thorndike (1928:124) expresses the opinion that in general almost anything is learnable at any time up to

50 years of age. The primary difficulty expected in learning at late ages is in part due to a sensitiveness to ridicule, adverse comment, and undesired attention.

Adolescence (12-18 years)

Knowles (1950:17) hypothesized that there is a widespread myth that adults lose the ability to learn as they leave the twenties. This concept has definitely been destroyed by modern psychological research. Extensive studies by means of intelligence tests shows that mental ability grows rapidly during adolescence, reaches its peak during the late teens or early twenties, and then gradually declines at the rate of about 1 percent each year after forty years of age.

Table 1

Physiological Factors: Adolescence

Age	Condition/Event
12	The near point of vision (the distance from the eye at which an object can be seen clearly) begins to move away from the eye.
15	Peak physical performance is reached.
18	Maximum reaction speed is obtained.
18 1/2	Visual acuity attains maximum.

Early Adulthood (18-29 years)

Knowles (1980:91) feels that this development stage happens when vocational and family interests tend to dominate the pattern of concerns of young adults as they seek to establish themselves in work and home. Rossman (1984:28) presents a second concept that it is clear that learning ability does not significantly change from the early twenties through later life. Capable individuals, according to Rossman, in their early twenties do not suddenly become dull or obtuse in their later years. Similarly, it is impossible for one with limited ability to become an overachiever in later years.

Table 2

Physiological Factors: Early Adulthood

Age	Condition/Event
20	23% of all learners suffer from reduced (poor) vision.
20	For normal learning task, 100 foot-candles of light is needed.
25	Hearing discrimination begins to decrease.

Lumsden (1985) points out that an estimated 48 percent of American college students are over the age of 21, with nearly 11 percent over the age of 35. Most

educators predict that the number of older students will continue to increase for sometime to come.

Middle Adulthood (30-35 years)

Levinson (1978) in his text The Seasons of a Man's Life views middle adulthood as the single most important aspect of growing up and growing old. The middle adulthood stage, according to Levinson, sees the forming of friendships, the development of a family, and the changing of one's work spirit from that of worker to proven professional or journeyman worker.

Table 3

Physiological Factors: Middle Adulthood

Age	Condition/Event
30	More blue light is needed to see shades of blue. Color discrimination begins to decrease.
35	Relationship between yellow-blue starts to decrease due to the aging of the eyes.
35	38% of all adults wear corrective eye glasses.

In closing, Lovell (1980:19) views the middle adulthood stage as a gradual one marked by social and economic changes. Lovell (1980:98) closes by expressing the opinion that although there is great diversity amongst

people, most individuals are remarkably consistent over long periods of time in the way that they think, experience their environment, and behave towards it.

Maturity (35-55 years)

Rossman (1984) points out that less than 2 percent of the people over the age of 40 do not need eyeglasses. Bischof (1969:208) concurs with this opinion. The human is rare who has lived past the age of 40 without realizing that visual acuity decreases with age. Bifocals and trifocals are the order of the day. He goes on to express the concept that almost all studies show that visual efficiency declines rapidly after the age of 40.

This decrease in visual effectiveness at age 40 is basically seen in four ways. First, changes take place in pupil diameter of the over forty person's eyes. Next, a strong yellowing of the lens reduces the eye's ability to see colors. Thirdly, the eye starts to show a strong increase in sensitivity to light and especially to glare. Finally, a change takes place in the eye's ability, for people past 40, to adapt to the dark and quick changes to light levels (Bischof, 1969:209).

Table 4

Physiological Factors: Maturity (40-44)

Age	Condition/Event
40	All humans show significant slowing of reaction times.
40	Verbal skills show a slight growth or no decrease.
44	The most finely tuned athlete shows a 10% performance loss per year after age 44.

Most authorities agree that the ability to hear high-pitched sounds is lost first and usually after age 40. The majority of adults, however, rarely lose the full ability to hear low-pitched tones (Bischof, 1969:210). Hearing impairment increases gradually until the fifties and then the rate increases rapidly (Knox, 1977:314).

Table 5

Physiological Factors: Maturity (45-55)

Age	Condition/Event
45	Most striking change in near vision occurs at this age to age 55.
45	A marked general loss of hearing starts to take place. This trend continues rapidly until age 65.
50	180 foot-candles of illumination are needed for normal learning task.
55	Highest decrease in hearing discrimination starts to take place.
55	Vision losses have stopped and the eyes will stay at this level if disease free.

In the area of verbal skills there is a positive note. Verbal skills show only a slight growth during this stage or at least no real decrease. In general, almost anything is learnable at any time up to age 50 (Thorndike, 1928:124).

Later Maturity (55-60 years)

During this last stage, in connection with agency employment, the individual shows signs of visual and hearing problems which starts to affect every aspect of the workplace. The highest decrease in hearing discrimination

starts to take place during this life stage. Men experience greater hearing loss than women beyond the fifties, largely as a result of occupational exposure to noise (Knox, 1977:283). Natural hearing loss is compounded by what Knox (1977) calls "socially impaired hearing loss". This occurs when the hearing loss constitutes a reduction of about thirty decibels and other people become aware of the deficiency (Knox, 1977:283).

Table 6

Physiological Factors: Later Maturity (55-60)

Age	Condition/Event
56	The average world class athlete has died. Olympic stars over age 65 are rare.
60	Vision: (loss of good vision) has occurred in all humans.
60	Individuals find it hard to follow rapid speech despite little or no hearing loss.
60	Mobility becomes a problem due to joint and bone disease. Shrinkage of bones due to low calcium takes place at an ever increasing rate.

In the area of vision and later maturity stage, vision: (loss of good vision) should level off between 52-55 years of age. If medical complications do not set in, one's vision at age 55 should stay at that level until the early 70s. Three-quarters of all adults over the age of 55 have

one or more chronic health conditions; many of these conditions are directly related to the eyes and eye movements in general (Knox, 1977:291).

The next chapter will compare these findings in comparison to the working conditions within the Phoenix Air National Guard. This area can be best summarized by the following passage: Extensive studies by means of intelligence tests show that mental ability grows rapidly during adolescence, reaches a peak during the late teens or early 20s, and then gradually declines at the rate of about 1 percent each year after 40 years of age (Knowles, 1950:17). In more recent studies, experiments involving actual learning situations reveal, however, that it is not the capacity to learn that declines, but the rate of learning. Thus, older adults have just as much capacity for learning as they have when they were younger. They merely learn a little more slowly (Knowles, 1950:18).

Environmental Factors

When investigating environmental factors that affect the workplace, Kurpius (1978:107) believes that business thrives if it is able to stay in tune with the consumer, refining its product or service in accordance with the fluctuating tastes and changing needs. Thus, the real educational institution must adjust its lifestyle to compensate for the needs of the student population.

There are eleven academic classrooms at the Phoenix Air Guard. Each classroom is used, during the drill weekends, for conducting classes and for the administration of testing materials. The classrooms vary in size and structure from a traditional type with student chairs and chalkboards to a nonstandard type of classroom with long tables and folding chairs. Each of the eleven classrooms was examined using a check sheet. The air conditioning duct work in each classroom was examined for adequate air flow and ducting in accordance with Air Force standards.

Exterior and interior windows were examined for the control of direct sunlight and were reviewed to see what effect they would have in the overall lighting situation. Temperature readings were taken with a calibrated wet bulb air thermometer. The readings were recorded in degrees Fahrenheit. Both outside temperatures and inside temperatures were taken to determine the cooling ability of the air conditioning systems to keep the rooms at 78 degrees (Federal EPA standards). Temperature sampling was done at 9 a.m. and 3 p.m. in order to provide a contrast between cooler morning temperatures and higher afternoon temperatures.

The next area that was examined was noise distractions. Two classrooms suffered heavily from industrial machine noise because they are located within production work shops. Jet noise (the facility is located on an international airport) played a key role in disturbing

the classroom environment in two cases. When the aircraft take off and land (approximately every eight minutes) the walls of the classroom shake or the noise drowns out normal conversation voice levels.

The following tables show the test results of the classroom evaluations. It is definite that repair orders could be submitted to repair noise distractions in the classrooms. Lighting (foot-candles) can be increased with brighter bulbs and alterations can be made to wall paint schemes. Spot industrial high intensity lighting could be purchased to improve the general work areas and classrooms needing a large degree of additional lighting. The heating and air conditioning problems can be corrected if the proper refrigeration engineers are used to evaluate the cooling and heating systems for each classroom.

Table 7

Environmental Factors: Classroom Examinations

Bldg. No. (Classroom	Temp. (a.m.) Inside/	Temp. (p.m.) Inside/	Lighting Lowest/	Noise Distraction
2 (103)	79°/71°	80°/94°	28fc/51fc	None
(117)	77°/71°	88°/94°	36fc/62fc	Loud Clock
(119)	78°/71°	80°/94°	30fc/54fc	Fan Noise
(121)	81°/71°	80°/94°	28fc/44fc	Machine Noise
(160)	76°/71°	78°/94°	50fc/70fc	A/C Noise
(203)	80°/71°	85°/94°	35fc/110fc	None
8 (103)	83°/79°	90°/94°	40fc/96fc	Machine Noise
10 (100)	84°/71°	88°/94°	20fc/32fc	None
14 (100)	84°/79°	84°/94°	85fc/105fc	Jet Noise
17 (4)	84°/79°	86°/94°	22fc/43fc	Jet Noise
25 (104)	80°/71°	82°/94°	42fc/66fc	None

Lighting levels, when measured with a light meter, took on a whole new approach with employees in work centers. Once this investigation started and other employees watched the taking of readings, they also wanted their areas tested. They borrowed the light meter after the rooms were tested and tested their areas. This was a positive spinoff of the study and the research that took place.

Finally, the temperature changes that took place in the classroom environments again brought about a different look at a long standing condition. Students would complain about certain classrooms being hot. These complaints were never looked into prior to this study. But when one examines Table 7 and sees that one classroom has an inside temperature of 88 degrees, while the outside temperature is

94 degrees, this could be expanded to infer that during normal summer conditions, the classroom temperature exceeds 100 degrees. This would not normally be considered acceptable for student learning and education.

Chapter 5

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This investigation was designed to review current literature in the field of physiological factors affecting the adult learner and to compare these findings to the academic learning environment at the Phoenix Air Guard. The end product is a set of recommendations for management to implement in order to improve the learning climate for the Phoenix Air Guard members.

Discussion

The research literature in the area of the nature of the adult learner and the physiological factors of aging produced a wealth of information that could not be contained in many books, let alone one short research paper.

When comparing the last four stages of adult lives, as defined by Havighurst, to the Phoenix Air Guard population, a strange imbalance was observed in connections with age stages. This imbalance is depicted on Table 8 entitled Phoenix Air Guard Age Groups which is contained on the following page of this study.

Table 8

Phoenix Air Guard Age Groups

Stage	Air Guard Population
Adolescence	1%
Early Adulthood	29%
Middle Age	19%
Maturity	49%
Later Maturity	2%

This information was not what was expected prior to the start of the investigation. It was expected that the population would be older than other work groups due to the low turnover rates experienced with employees who are over the age of 30. Once the employees reach 26-28 years of age, they have a tendency to stay with the Guard. With half of the base population being in the 35-55 year age group certain considerations involving physiological factors become very important. Thus, the study has even more importance than once thought because of the inverted type of aging in their work population.

Since 29 percent of the Phoenix Air Guard's population falls into the Early Adulthood stage, it is imperative that all members receive a good initial work physical to identify any poor vision trends or hearing losses.

During middle adulthood, the Phoenix Air Guard job becomes a focal point for each member's life. In keeping with Levinson's ideas, the guardsmen must look to succeed totally. Obtaining timely promotions and moving up the image ladder become of extreme importance. As each person passes through this stage he formulates a free "thy self" image that is flawless in nature.

The ages 35 to 55 are the high demand years within the Air Guard lifestyle. Here, the employee is looked upon to be both a journeyman worker and a key role supervisor. Once over 50, the Air Guard places these employees in the jobs with the highest level of responsibility. This is the key stage for the development of corporate knowledge and information. All of the major policy decisions are made by this single age group.

The physiological factors involving the aging of the human eye are extremely important in the industrial or military workplace. Alterations in lighting levels can be made and changes in the size of printed matter can be initiated in order to deal with a work population that is dependent upon glasses for visual improvements.

Less than 2 percent of the total Air Guard population falls into the last stage, Later Maturity. Bad health usually will cause an early retirement at age 55 or if they stay on to age 60, it usually is what one would consider the fighters or those without the proper number of years for retirement at age 55. With few exceptions, these

individuals are in command positions or are senior supervisors and have been removed from the physically demanding side of the military profession.

The best preventions for physiological problems caused by aging are identification of the potential problems and acting quickly with proper medical care. Once these physiological limitations are understood, recommendations for corrections can be made and implemented.

Conclusions

Based on the findings expressed in the discussion section, the following conclusions have been reached:

1. The ever changing jet noise level at Sky Harbor airport has an effect on student learning.

This conclusion is based upon the findings expressed in Table 7 showing that jet noise has a negative affect on two classrooms.

2. At least three classrooms have equipment producing noise distractions.

This conclusion is based upon the findings shown in Table 7 under noise distractions. Machine, clock, and air conditioning noises were all identified as problems in need of repair.

3. At least three classrooms need additional insulation to reduce classroom temperatures to acceptable levels.

This conclusion is based upon the findings shown in Table 7. Several rooms had less than a 6 degree span between the outdoor and indoor temperatures.

4. At least seven classrooms need additional lighting in order to raise their level to 70 foot-candle levels.

This conclusion is based upon the findings shown in Table 8. The normal requirement for classroom lighting is 70 foot-candles. Ratings of 100 foot-candles may be needed for adults with bifocals and trifocals according to Bischof. All areas under 70fc need to be improved with additional or replacement lighting.

Recommendations

The following recommendations are made based on the findings of and insights derived from this study.

1. Management at the Phoenix Air Guard needs to carefully analyze the physiological factors affecting learning and to incorporate changes that would improve the opportunities for learning by the employees.
2. Each employee over the age of 40 should receive annual eye and hearing checks instead of the current once each six year cycle. This would result in identification of hearing and vision losses sooner.

3. Repair orders should be initiated in order to repair broken or noisy air conditioning equipment.
4. Added insulation should be installed in the rooms identified in Table 7 as needing better cooling.
5. Additional lights should be purchased to upgrade the existing poor lighting levels. All classrooms should be raised to the 70fc level at least. Industrial work centers should be equipped with supplemental lighting to raise their levels to 100fc.
6. Finally, all adult learners should be watched by management for any signs of disease or aging that would result in their injury or the injury of others. This should include close monitoring of sick leave and extended periods absent from work without medical authorizations.

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